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THE CONCEPT OF VIRUSES AMONG FIRST AND SECOND GRADE PRIMARY SCHOOL STUDENTS

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Abstract. *Everyone has been interacting with the outside world since birth, creating ideas about various objects or phenomena. The main aim of the research was to identify the concepts of primary school students about viruses. In addition to finding out the level of ideas, additional aims were to determine the effect of gender, the degree of education attended, the residence, the presence of a doctor in the family and the perceived vulnerability to disease (PVD). The research sample consisted of 173 first and second grade primary school students. The research tool consisted of three parts. The first part was sociodemographic variables, the next part was a questionnaire focusing on the perception of one's own health. In the last section of the research tool, a children's drawing was used to determine the level of respondents' ideas about viruses. The data were analyzed using descriptive, inferential and multidimensional statistics methods. In most cases, drawings of viruses were relatively accurate. The level of education attended and perceived infectiousness were shown to be significant factors influencing the level of students' ideas about viruses. Due to a non-representative sample, the study brings only preliminary results. The anthropomorphic elements were often present in students' drawings in the first grade, it would be appropriate to consider what visual material should be used in the teaching process.*

Keywords: *categorical system, children's drawing, conceptions of viruses, primary school students*

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Introduction

Viruses are currently a widely discussed topic, especially in connection with the recent coronavirus pandemic, which significantly impacted not only adults but also children. The lack of interaction with peers, school closures, fear of contagion, and concern for loved ones are just a few examples of how students' daily lives were affected. During the pandemic, the author encountered various pieces of information about viruses that were inconsistent with scientific reality. Given that children's perceptions differ greatly from those of adults, understanding their initial ideas about viruses is crucial. This knowledge could serve as a prerequisite for developing educational materials that address key problematic areas, potentially reducing misconceptions about viruses among students. The primary aim of this study is to assess the level of understanding primary school students have about viruses and to determine whether selected variables—such as gender, grade level, residence, presence of a doctor in the family, and perceived vulnerability to disease—play a role.

Misconceptions are defined as incorrect, erroneous, or incomplete understandings of concepts that diverge from scientific knowledge. These misconceptions exhibit several typical characteristics. First, they occur regardless of gender, age, social status, or cultural background. Second, individuals of different ages often use them to explain natural science phenomena. Third, misconceptions tend to resist conventional teaching methods. Fourth, they become integrated into students' cognitive structures alongside other information provided by teachers. Additionally, misconceptions are often simple explanations of reality—similar to the ideas proposed by ancient philosophers—which makes them easier for people to understand and believe. Lastly, misconceptions frequently arise from direct observation and media influence (Doulik et al., 2024; Jammeh et al., 2023; Leonard et al., 2014). The field of students' ideas about viruses, bacteria, or microorganisms in general was previously one of the few explored. Nevertheless, several authors have contributed valuable insights to this topic in the past, including Nagy (1953) and Kalish (1996). In recent years, however, the number of research papers examining these ideas has increased. Byrne et al. (2009) investigated the anthropomorphic and anthropocentric perceptions of children regarding microorganisms. The study

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involved a sample of over 400 primary school students. Data analysis revealed that students generally held negative attitudes toward microorganisms and largely ignored their positive roles. Anthropomorphic representations of microorganisms were especially prevalent among younger students. Prokop et al. (2016) examined whether a child's personal experience with illness influenced their perceptions of microorganisms. In this study, children were asked to draw what they imagined germs looked like. Results indicated that children who were sick more frequently depicted microorganisms as smaller and used darker colors in their drawings compared to those with less experience of illness. No significant effects of age or gender were observed. Approximately 50% of children drew microorganisms with circular shapes, often incorporating human features such as legs, hands, or mouths. Some drawings even portrayed microorganisms as human figures. Among the drawings, 50% included two hands, while 40% omitted hands entirely; a smaller proportion depicted four hands. Similarly, 49% of microorganisms were drawn with two legs, while 25% had no legs. Most children (71%) included only one microorganism in their drawings, while the remainder depicted two or more. The size of the drawn microorganisms ranged from 4 to 30 cm. Furthermore, 55% of participants used multiple colors in their illustrations, whereas 45% opted for single-color representations. Similar findings have been reported in other studies (e.g. Assante & Candel, 2020; Gregorio et al., 2019; Idoiaga et al., 2020; Karadon & Sahin, 2010; Milandri, 2004; Simon et al., 2017; Simonneaux, 2000; Tinuola, 2016). As mentioned earlier, studies focusing on children's understanding of viruses, bacteria, and microorganisms in general have been increasing. The heightened interest in students' conceptions of viruses in recent years is primarily attributed to the pandemic caused by SARS-CoV-2, which affected the entire world. Bray et al. (2021) conducted research examining children's representations of the coronavirus. This study involved 128 children aged 7 to 12 years from six countries: the United Kingdom, Australia, Sweden, Brazil, Spain, and Canada. According to the authors, nearly half of the drawings closely resembled the actual image of SARS-CoV-2. The virus was most frequently depicted as green, circular in shape, and adorned with spikes. The words chosen by children to describe the virus were typically menacing, diabolical, and evil. The illustrations also included details about transmission methods (e.g., sneezing, coughing, handling contaminated objects) and preventive measures (e.g., regular handwashing, disinfection, wearing masks, maintaining social distance). Martinerie et al. (2021) found that a red or green circle with a crown composed of spongy surface protrusions represented the most common cartoon depiction of the coronavirus among children. Additionally, 37% of the drawings included anthropomorphic features such as eyes, sad or smiling mouths, or sharp teeth; 24% were drawn in three dimensions. Bonotti et al. (2022) investigated children's perceptions of the coronavirus through drawings and verbal descriptions. Their findings revealed that children demonstrated a remarkable understanding of the coronavirus and its medical, social, and psychological impacts on people's lives from an early age. A significant proportion of children incorporated anthropomorphic elements into their drawings. Furthermore, no substantial differences in children's perceptions of the virus were observed across different age groups. Similar patterns in virus illustrations during the pandemic were reported in other studies. (Carlsson et al., 2023; Christidou et al., 2022; Duran, 2021; Pocsova et al., 2021; Qekaj-Thaqi & Thaqi, 2021; Walters et al., 2022).

Research Problem

The literature review indicates that studies utilizing drawings to assess participants' understanding of various biological phenomena encompass a wide range of age groups, from primary school students (e.g., Edelsztein, 2024) to adults (e.g., Waters et al., 2023). However, primary school students are underrepresented in the research samples, as greater attention is typically given to older students in elementary or high schools. This focus aligns with the developmental stage at which students form their final concepts about different phenomena, not limited to biology (Hadenfeldt et al., 2016). Identifying topics that pose challenges for these students and addressing any misconceptions they may hold is therefore crucial. Another significant issue is the limited coverage of viruses in the biology curriculum at Czech primary schools. The curriculum provides only fragmented information about viruses and their morphology, potentially leading to distorted perceptions among students regarding the appearance of viruses. Furthermore, there is a notable lack of research on this topic; existing studies have not sufficiently explained the phenomenon.

Research Focus

Research was focused on finding out the factors which can influence concepts about viruses. The main aim of the research was to identify the concepts of primary school students about viruses. The additional aims were to find out the influence of selected factors (gender, grade level, residence, presence of doctor and perceived vulner-

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ability to disease) on concepts about viruses among primary school students. In line with the aims, the focus of this research was to answer the following questions:

1. What are the primary school students' conceptions about viruses?
2. What is the influence of selected variables (gender, grade level, residence, presence of doctor and perceived vulnerability to disease) on primary school students' virus conception?

Research Methodology

General Background

The study employs a quantitative approach to collecting and analyzing data. To answer the research question, a research tool was administered to a sample of Czech primary school students. The tools were distributed in paper-and-pen form during the second term of the 2022/2023 academic year, and data collection lasted four months. Participation in completing the research tool was voluntary, and respondents' anonymity was guaranteed. No incentives were offered to those who provided responses. The study presents preliminary results of the research due to a non-representative sample.

Sample

The research was conducted during the 2022/2023 academic year at four primary schools in the Czech Republic. A non-random sampling method was employed for participant selection. Participants were not intentionally chosen but were based on the willingness of teachers to participate in the research. The schools were accessible to the researchers, who had personal contacts with the school directors. The research sample consisted of 173 primary school students who voluntarily participated in the study. The total number of 325 students was addressed. However, 53% agreed and filled out the questionnaire. Students from all years of the first and second grades were included. The study adhered to ethical guidelines and was approved by the Ethics Committee of the Faculty of Education, Jan Evangelista Purkyne University, under reference number 3/2022/02. The committee confirmed that the study complied with valid principles, regulations, and international guidelines for research involving human participants. A total of 96 students from the first level participated in the survey: 11 students from the first year, 21 from the second year, 17 from the third year, 27 from the fourth year, and 20 from the fifth year. At the second level, 77 students completed the questionnaire: 20 students from the sixth grade, 13 from the seventh grade, 20 from the eighth grade, and 24 from the ninth grade. Gender representation among respondents was relatively balanced, with 92 girls and 81 boys. The majority of participants (n = 131) came from rural backgrounds, while a smaller proportion (n = 42) were from urban areas. Additionally, 29 students reported having a doctor in their family. The age range of participants spanned from 7 to 16 years.

Tool

The research tool consisted of several parts. The introductory section included a description of the research aims, followed by information on its implementation and demographic variables. Demographic data collected included the respondent's gender, age, grade level, place of residence (village or city), and whether there was a doctor in the family. The second section of the research tool featured a questionnaire titled Perceived Vulnerability to Disease (PVD), comprising 21 Likert-type items measured on a 5-point scale (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree). The first 14 items focused on perceived vulnerability. This questionnaire was originally developed and validated by Duncan et al. (2009). Among these 14 items, eight conveyed positive meanings, while six conveyed negative meanings. A higher score indicated greater perceived vulnerability. The questionnaire was divided into two sub-dimensions: perceived infectivity (items 1, 6, 8, 10, 12, and 14) and germ aversion (items 2, 3, 4, 5, 7, 9, 11, and 13).

The remaining seven items in the second section targeted perceived disgust. This questionnaire was initially used in a study by Fancovicova et al. (2013). Since it was originally written in Slovak, translating it into Czech posed minimal challenges. All items had positive connotations; higher scores reflected greater resistance levels. Items with negative meanings were reverse-coded. The final section of the research tool utilized numerical symbols within a categorical system for evaluation. To ensure methodological rigor, reliability testing was conducted for the sections incorporating Likert-type items – specifically, the perceived vulnerability questionnaire and its components.

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Cronbach's alpha (α) was calculated to assess reliability for both the entire questionnaire and its subcategories. The overall questionnaire achieved an α value of .74, indicating high reliability (Nunnally, 1978). Subcategories exhibited α values ranging from .64 to .72, demonstrating adequate reliability. Additionally, normality tests were performed using the Kolmogorov-Smirnov test (*d*) to determine whether parametric statistical methods could be applied to interval-level data. The test yielded a d value of .06 ($p > .20$), confirming normal data distribution. Normality tests for each questionnaire component also supported this finding; detailed results are presented in Table 1.

Table 1
Normality Values for Each Component of the Self-health Perception Questionnaire

Components of questionnaire	*d*	*p*
Perceived vulnerability	.05	> .20
Perceived resistance	.09	> .05
Perceived infectivity	.07	> .20
Germ aversion	.06	> .20

d – value of normality, *p* – level of significance

The final part of the research tool focused on respondents' ideas about viruses in general. To identify these ideas, the research method employed was children's drawings. Students were given blank A4-sized paper and asked to draw what they thought a virus looked like. This process is possible to find in some other studies, where some aspects of science (biological) education were examined (Chang, 2012; Howlett & Turner, 2023; Prokop & Fancovicova, 2006). Since no suitable categorical system for the purposes of the research could be found in specialist literature, a custom system was developed.

Categorical system for evaluating the level of respondents' ideas about viruses:

Category 1 - Presence of coronavirus (subcategory: yes; no)
Category 2 - Color of virus (subcategory: light; dark; colorless)
Category 3 - Presence of an anthropomorphic element (subcategory: yes; no)
Category 4 - Depiction of prevention strategy (subcategory: yes; no)
Category 5 - Showing how the virus is transmitted (subcategory: yes; no)
Category 6 - Number of viruses displayed (subcategory: one; two; three, or more)
Category 7 - Number of virus shapes displayed (subcategory: one shape; multiple shapes).

Data Analysis

After completing the data collection, the data were first recoded into numerical form for statistical processing. The items from the second part of the research tool were recoded according to the points. In analyzing the data, two statistical approaches were employed to meet the research aims. The first approach involved considering the frequency of representation of each virus drawing category as the dependent variable and the average score of perceived vulnerability to disease and its individual components as the independent variable. In this case, analysis of variance (ANOVA) was used. Since some variables (drawing categories) contained more than two groups, Tukey's post-hoc test was applied to determine intra-group differences. This method is commonly used in socio-scientific research investigations (Maxwell, 1980; Sun, 2019).

The second statistical method was the chi-square independence test (χ^2), where independent variables had the character of nominal variables. The findings, through statistical analyses, are presented in verbal, tabular or graphical form. The statistical test results are reported at three levels of significance ($p < .05$; $p < .01$; $p < .001$). Microsoft Excel spreadsheet and statistical software STATISTICA 10.0 were used for data processing.

Research Results

In Figure 1, the distribution of scores across each category of a categorical system designed to evaluate respondents' perceptions of viruses is presented. Over 80% of respondents illustrated a virus resembling the coronavirus in shape. Less than 50% of the drawings employed dark colors, followed by those using light colors. The least frequent were "colorless" drawings, where students depicted the virus only in outline using a pencil or

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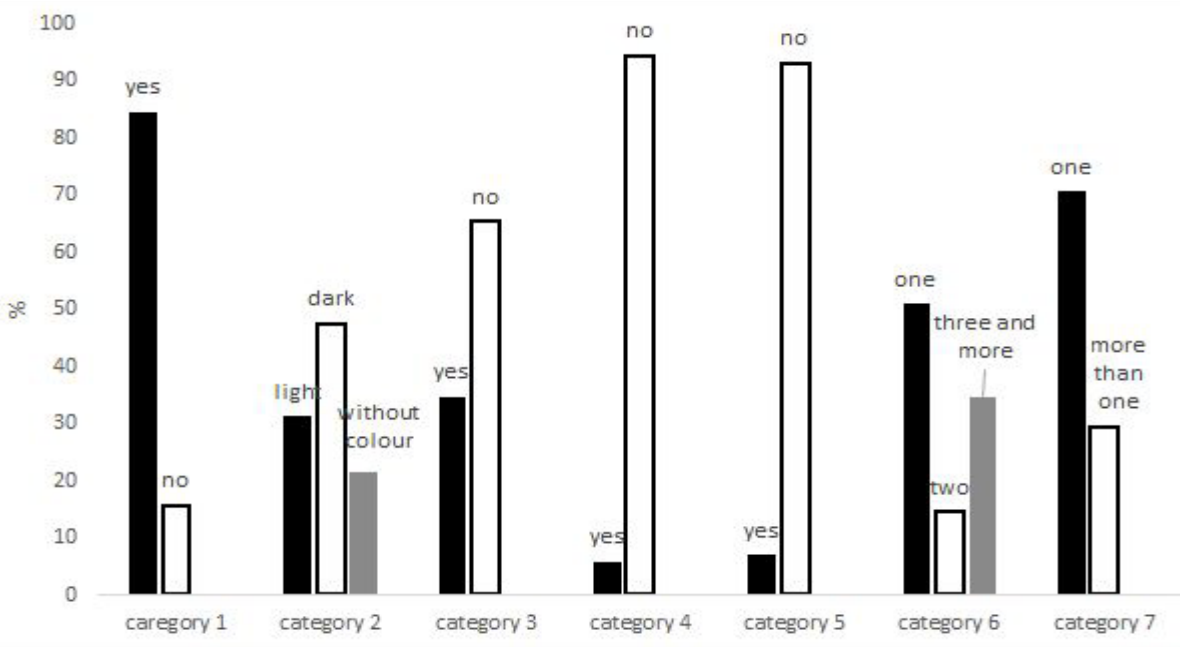
pen without adding color. Approximately one-third of the students incorporated anthropomorphic elements into their virus illustrations. A small proportion of drawings (just over 5%) included representations of preventive strategies or methods of virus transmission. Another category analyzed was the number of viruses depicted in the drawings. Half of the students illustrated a single virus, less than 35% included three or more viruses, and 15% depicted two viruses. Regarding the number of virus shapes displayed, 70% of the drawings featured one shape, while 30% included multiple shapes.

Figure 1
Score Distribution with Respect to Categories



The perceived vulnerability to disease and its individual components did not influence the perception of the virus or individual categories, except for perceived infectivity. Lower scores in perceived infectivity were observed among students whose drawings lacked representations of the mode of transmission. Table 2 presents an analysis of variance values, confirming the insignificance of these variables.

Table 2
Analysis of Variance Within Each Virus Perception Category with Respect to Health Perception

Variables	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6	Category 7
Perceived vulnerability to disease	.17	1.99	.21	.45	.55	.40	.18
Perceived vulnerability	.17	1.97	.001	.29	2.06	1.18	1.35
Perceived disgust	.06	1.38	.86	.32	.25	.09	.58
Perceived infectivity	.46	.03	.20	.14	7.30**	1.20	.75
Germ aversion	1.13	2.82	.10	.17	.05	.32	.68

** $p < .01$

Among the other variables, the gender of the respondents did not manifest significantly in any of the categories studied, similarly, the residence or presence of a doctor did not affect them. Only the grade attended proved to be a significant factor. A significant difference was determined in the category "color of the virus" ($\chi^2 = 35.70$; $p < .001$; $df = 2$). Since the above variable had more than two groups, z-score was used, and it was identified that

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first graders drew viruses with dark color to a significant extent ($p < .05$) and second graders drew more pictures without using color ($p < .001$).

A statistically significant difference ($\chi^2 = 7.83$; $p < .01$; $df = 1$) was also demonstrated for another observed category, the presence of an anthropomorphic element, depending on the grade level. Students attending first grade incorporated anthropomorphic elements into their drawings to a greater extent than students from second grade. For the category 'number of viruses displayed with respect to degree of education', a statistically significant difference in results was identified ($\chi^2 = 9.40$; $p < .01$; $df = 2$). Due to the fact that the above variable had more than two groups, the z-score was used, and it was found that the respondents attending the second grade showed more than one virus in their drawings compared to the first-grade students. A statistically significant difference was detected for the last category, called "number of displayed virus shapes," with respect to respondents' degree of education. Although both groups displayed only one shape of the virus more often in their drawings, the second-grade students drew them to a greater extent than the first-grade students ($\chi^2 = 5.05$; $p < .05$; $df = 1$). The individual values of the chi-square test are shown in Table 3.

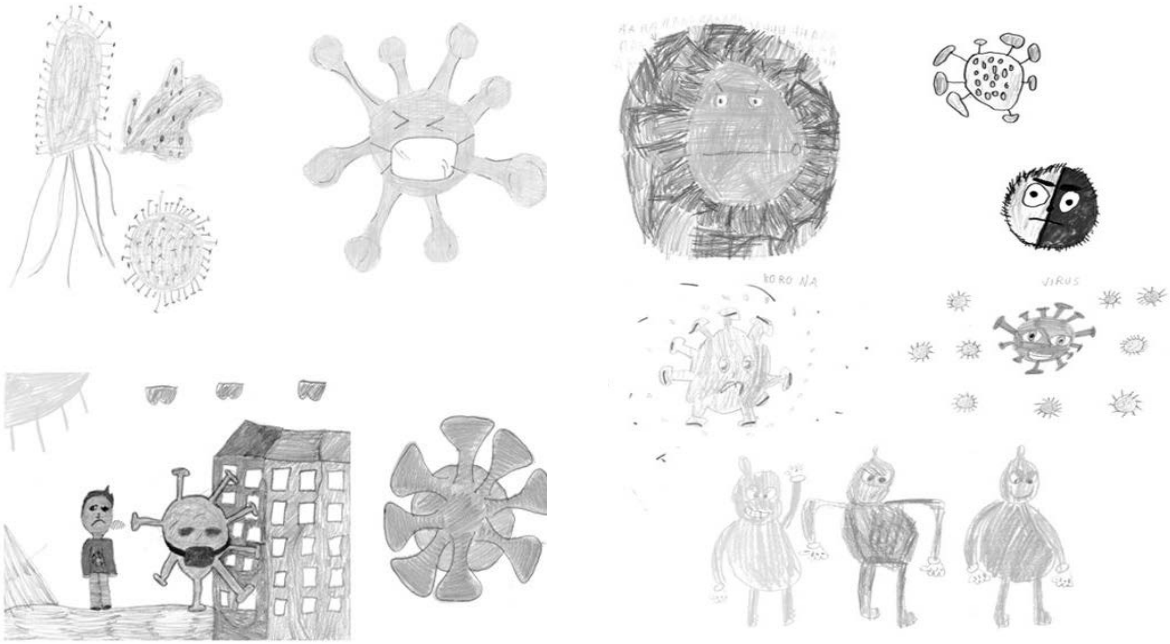
Table 3
Chi-square Test Value (χ^2) Within Each Virus Perception Category with Respect to Demographic Variables

Variables	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6	Category 7
Gender	.98	1.87	.12	.20	.05	4.34	.39
Grade level	2.82	35.70***	7.83**	.90	.90	9.40**	5.05*
Residence	.50	1.90	.04	.19	0.04	2.50	3.23
Presence of a doctor	.73	5.49	2.84	.08	.07	.82	.04

* $p < .05$; ** $p < .01$; *** $p < .001$

Regarding the drawings themselves, first-grade students frequently depicted the coronavirus alongside other elements, such as shapes resembling amoebas, blood platelets, or centipedes. The viruses were often portrayed in green. Additionally, there were drawings illustrating preventive strategies or ways the virus could be transmitted (Figure 2).

Figure 2
Examples of Viruses Drawings by First Grade Students



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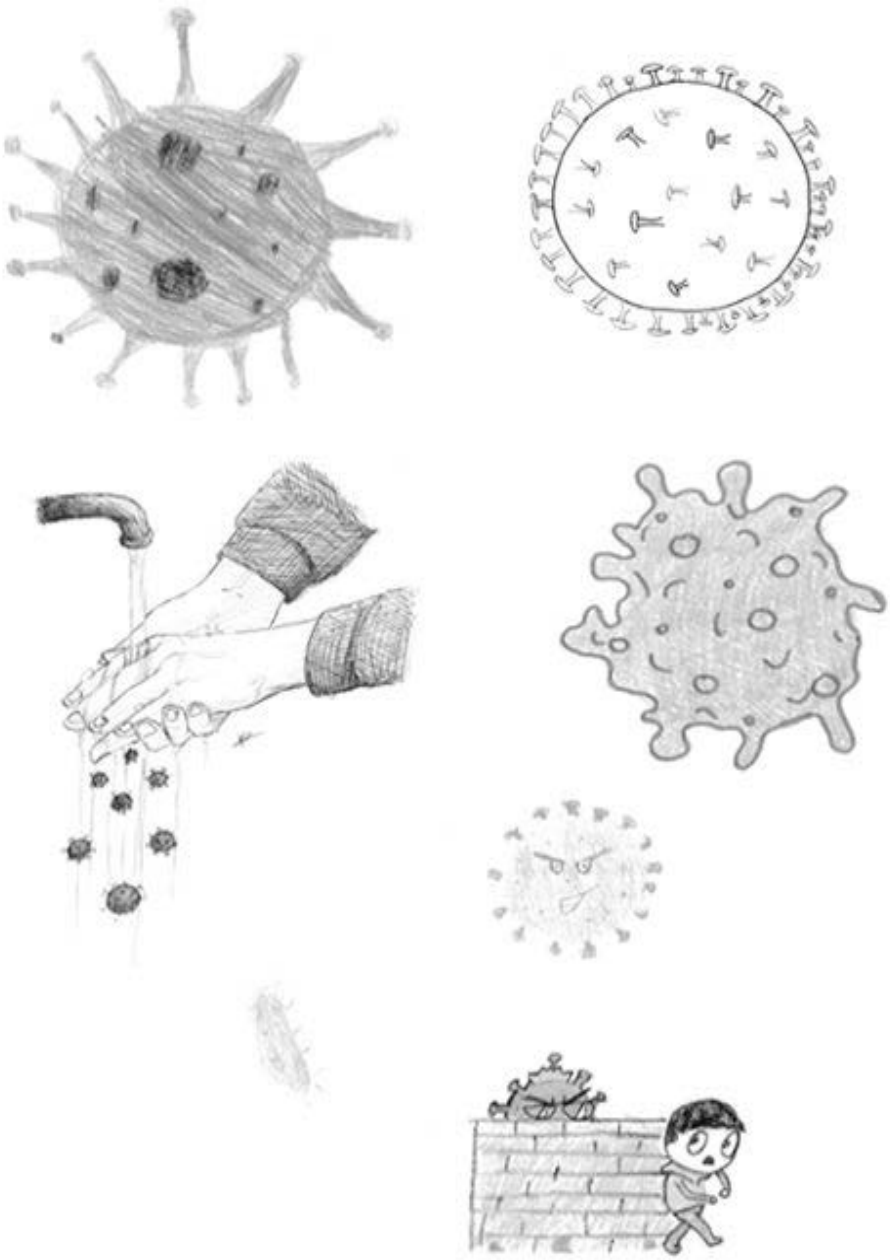
Examples of drawings by second-grade elementary school students are shown in Figure 3. The shapes attributed to viruses by second-grade students did not differ significantly from those drawn by first-grade students. The most common representation was the coronavirus shape, followed by centipede-like, oval, or iridescent shapes. One drawing included an attempt to depict a bacteriophage. While green remained the most used color, most second-grade drawings were created using a pencil or pen without coloring. Compared to first-grade drawings, fewer second-grade illustrations included anthropomorphic elements. Additionally, the names of certain viral diseases, such as Ebola and influenza, appeared in some drawings.

Figure 3
Examples of Virus Drawings by Second Grade Students



On the figures are represented only the typical drawings for the selected categories. The coronavirus was the most often represented type of virus among first and second grade students.

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Discussion

Through the children's drawings, it was identified that most students had relatively adequate ideas about viruses. Most commonly, respondents depicted a single virus with a circular shape and spikes. The most used color was dark green. A smaller portion of the drawings also contained anthropomorphic elements. The mode of transmission of the virus and the prevention strategies were rarely displayed.

Our findings were in concordance with other studies, for example, in a study by Bray et al. (2021), it was also found that drawings showed a considerable understanding of the form of viruses. Some of the drawings also contained anthropomorphic elements. A similar trend could be observed, for example, in studies by Martinerie et al. (2021) or Duran (2021). While respondents' overall depiction of viruses can be assessed as generally accurate, based on the results, it is possible to conclude that the child's image of the appearance of the virus is largely influenced by the media, in which visual images of the coronavirus, often also with anthropomorphic elements, were widely displayed during the pandemic (McGellin et al., 2021).

Although the main aim of this study was to find out students' concepts about viruses, it is evident that the pandemic crisis has significantly affected students in this area, as most of them recall the coronavirus as the virus. At the same time, studies suggest that even students perceived the medical, social and psychological effects of the coronavirus crisis not only on their lives, but also on the lives of their loved ones. "Another area of study was the gender difference in children's virus drawings. The results indicated that gender was not a significant factor. This finding agrees with the results of the authors Prokop et al. (2016), who devoted their work to, among other things, what ideas about microorganisms' children attending kindergartens have. The researchers cite authors such as Curtis et al. (2004), who argued that women should have different levels of understanding of microorganisms from men in evolutionary terms, due to the fact that women are more likely to care for children, and so their concern stemming from microorganisms and the child's subsequent illness is significantly higher.

Another factor influencing students' ideas about viruses was the degree of education attended, which was statistically significant in the results. In the presented study, a notable difference was observed in the categories of anthropomorphic elements, virus color, the number of viruses displayed, and the variety of virus shapes depicted. Data analysis revealed that first-grade students incorporated more anthropomorphic elements into their drawings compared to second-grade students.

These findings align with Byrne et al. (2009), who noted that anthropomorphic features decrease significantly with age in children's drawings. Anthropomorphism is a hallmark of preschool-aged children's artistic expression, making it understandable that older students displayed fewer anthropomorphic elements. Previous studies have demonstrated that students often use anthropomorphism to articulate ideas that are otherwise challenging to express due to limited scientific knowledge or technical terminology (Inagaki & Hatano, 1987). Furthermore, significant differences were identified in students' verbal descriptions; older students provided realistic and science-oriented explanations, while younger students employed anthropomorphic, mythic, or symbolic language.

In the virus color category, first-grade students were found to use dark colors to a significant degree, while second-grade students drew viruses without using color. These results can be explained in two ways. Firstly, younger students might prefer their drawings to be more colorful, while older students may be content with simpler drawings. Secondly, although less likely, older students might have already learned about viruses in class and therefore know that viruses themselves have no color, which is why they didn't attribute any to them. In the category of the number of viruses displayed, it was observed that statistically, respondents from the second stage (second grade) more frequently depicted a single virus compared to those from the first stage (first grade). This is linked to the previous significant results, where in the category of the number of displayed virus shapes, second-grade students were more likely to draw only one shape of a virus compared to first-grade students. This could be because older students are satisfied with simple, realistic drawings, while younger students want their drawings to be more detailed and sophisticated. It could also be based on the development of drawing skills, where younger school-age students are in a phase of visual realism. This period is characterized by students drawing everything they know about a given topic, resulting in drawings full of details. Around the beginning of second grade, the development of drawing comes to an end, and students enter a phase known as the crisis of visual expression. This phase is marked by increased self-criticism of their artistic expression, leading students to often resort to drawing mere diagrams or models. It is also worth mentioning the last two categories: the depiction of how the virus is transmitted and the depiction of preventive strategies. Although no significant differences were detected, younger students scored higher in both categories, meaning they more frequently included methods of virus transmission or preventive

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strategies in their drawings. This aligns with the findings of a study by Bonoti et al. (2022), where younger students also depicted virus transmission methods or pandemic restrictions to a greater extent.

The additional aim of the study was to determine whether the level of virus-related drawings varied based on the respondents' residence. The results revealed that residence did not statistically significantly influence the depiction of viruses in the drawings. However, slight differences were observed between urban and rural respondents. Urban students tended to include more preventive strategies and representations of virus transmission in their drawings. This may be attributed to their frequent exposure to viruses in public spaces such as transportation systems, shopping centers, and service facilities. For example, during the COVID-19 pandemic, preventive measures likely had a greater impact on urban residents than on those living in rural areas. Rural students were able to maintain physical distance more effectively, access nature freely, and avoid constant mask-wearing or frequent use of disinfectants. Conversely, rural students scored higher in categories such as the presence of coronavirus imagery, anthropomorphic elements, and depictions of a single virus shape. This could be due to their comparatively limited exposure to media, which serves as a primary source of information about viruses (e.g. Karadon & Sahin, 2010). No studies were identified during the research that specifically examined the correlation between respondents' residence (urban vs. rural) and their ability to depict viruses through drawings. Despite this gap in literature, similar studies conducted globally have yielded comparable results. Furthermore, the drawings included various slogans and characters associated with pandemic-related campaigns. For instance, some respondents from the United Kingdom incorporated the slogan "Catch it. Bin it. Kill it." from the British government's official hygiene promotion campaign during the COVID-19 pandemic.

Differences in students' understanding of viruses based on the presence of a doctor in their family were not identified. Respondents who reported having a doctor in the family more frequently included anthropomorphic elements in their drawings but depicted virus transmission methods less often. It was presumed that students with doctors in their families would be more informed about viruses or illnesses due to their communication with parents and exposure to discussions about viruses. These students were expected to demonstrate greater expertise compared to others. Contrary to this expectation, students with doctors in their families more frequently illustrated preventive strategies and the coronavirus in their drawings. This result may be attributed to the heightened vulnerability of healthcare professionals during the coronavirus pandemic, as they were in constant contact with infected individuals. Consequently, these professionals likely emphasized preventive measures and educated their children about them. The lack of statistically significant differences between categories suggests that all students were equally affected by the pandemic, regardless of their parents' occupations. The presence of a doctor in the family was not extensively examined as a demographic variable in prior research. Only one study by Martinerie et al. (2021) explored students' perceptions of the coronavirus, including whether their parents were healthcare professionals. This study found no significant association between parental occupation and students' perceptions of the coronavirus.

The final observed variable potentially influencing students' virus imagery levels was perceived vulnerability to disease. The questionnaire assessed respondents' self-perceived health through two subscales: perceived resistance and perceived vulnerability. While perceived resistance showed no significant association with any categories of interest, perceived vulnerability demonstrated a statistically significant effect. A marked difference emerged in depictions of viral transmission modes. Participants scoring higher in the perceived infectiousness subgroup more frequently depicted transmission mechanisms in their drawings. This aligns with the hypothesis that individuals who perceive themselves as more susceptible to infection may consciously recognize pathways through which pathogens could infect them. Notably, Stangier et al. (2022) have explored similar relationships between perceived vulnerability and health-related behavioral outcomes. No statistically significant differences were found in the depiction of preventive strategies; however, a marginally higher prevalence of such strategies appeared in drawings by students with elevated perceived vulnerability scores. A parallel trend occurred in the representation of coronavirus presence: respondents with higher perceived vulnerability scores more consistently included the virus in their illustrations. These findings echo work by Tare and Bendre (2022), who identified positive correlations between COVID-19 infection rates and both perceived infectiousness and germ aversion subscales. Comparable results have been documented in studies by Díaz et al. (2020) and González-Castro et al. (2021).

Limitations

The crucial limitations of the presented research are the sample size and the selection of respondents. The authors are aware that the sample size is not representative, on the basis of this fact, the study presents only pre-

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liminary results. The findings are interpreted with this limitation in mind, and a future study using a representative sample from more schools is recommended. Another limitation lies in the first-time use of the categorization system for virus drawings. Further research involving different age cohorts is needed to assess the usability of this system.

Conclusions and Implications

Anthropomorphic elements were frequently detected in first-grade students, suggesting the need to carefully select visual materials for teaching. The focus should be on addressing and eliminating this misconception. Regarding virus shapes, students predominantly depicted circular forms. To enhance understanding, it would be beneficial to present a more diverse portfolio of virus images showcasing various shapes. This study offers only a preliminary report on students' conceptualizations of viruses, highlighting opportunities for further research. Future investigations could incorporate conceptual maps to explore students' ideas about viruses more deeply. Analyzing the most commonly used words in these maps could provide additional insights. Complementary research methods, such as interviews with respondents, may also be valuable for gathering more detailed data.

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Declaration of Interest

The authors declare no competing interest.

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